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concentrate in the tissues of aquatic organisms for years after they are applied. While DDT has been banned, other organochlorine pesticides such as dicofol and endosulfan remain in use throughout California's Sacramento and San Joaquin Valleys.

Organophosphate pesticides are also found in the Bay-Delta watershed. While less persistent than the organochlorines, at high enough concentrations organophosphates can be acutely toxic to aquatic organisms.

Thank you Manfred Lockhart

P.O. Box

66

Frazier Park, CA,

93222

FARMING PRACTICES THAT PROTECT WATER QUALITY

Water conservation and pesticide use reduction can help improve Bay-Delta water quality. Water conservation can improve water quality by reducing the volume of surface runoff and subsurface drainage, by potentially reducing the pollutant loads of the remaining subsurface drainage, by allowing more efficient application of agricultural chemicals, and by limiting irrigation-induced erosion and sediment loads.

In addition to improving water quality, water conservation can leave more water in rivers, streams, and wetlands for fish and wildlife, as well as reduce the number of fish killed directly by water diversions. Conservation can also help farmers increase crop yields and quality, and reduce production costs as a result of water and energy savings, and reduced pesticide and fertilizer applications.

Alternative pest management techniques can minimize pesticide contamination of the Bay-Delta ecosystem. Many of these techniques, including cover crops, soil building, and crop rotation, are designed to prevent conditions that encourage pest problems, thereby eliminating the need for chemical intervention. Other alternative techniques control pest populations by enhancing populations of natural predators, or by relying on natural or less toxic substances to reduce or eliminate pests.

CASE STUDIES

This report illustrates on-the-ground situations where water conservation and pesticide reduction techniques are being used successfully, and where farmers have found that these techniques maintain or increase the economic viability of their farming operation. Farmers and programs profiled for this report include:

West Stanislaus Hydrologic Unit Area (HUA) Program, Stanislaus County. The HUA program was developed to reduce runoff of pesticide-laden sediment into the San Joaquin River. Using a mix of information and education, cost-sharing, technical assistance, and monitoring and evaluation, the program has reduced water use by 18 percent, saving over 12,000 acre feet of water per year. Cumulatively the program has prevented over 718,950 tons of sediment from entering the impaired San Joaquin River.

John Texiera of Trecho Farms in Los Banos. Through his extensive soil building program and use of drip irrigation John has reduced herbicide use by 30 percent, synthetic fertilizer use by 25 percent, and water use by 50 percent.

Jim and Deborah Durst in Esparto. Using crop rotations, building soil fertility, and using other integrated pest management techniques, the Dursts have completely eliminated use of synthetic pesticides and fertilizers.

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Lundberg Family Farms in Richvale. Using creative irrigation and integrated pest management (IPM) techniques, the Lundbergs have reduced synthetic pesticide use 100 percent on organic fields and 50 percent on Nutra-farmed fields, and have also reduced water use by 25 percent.

Panoche Drainage District in Fresno County. Panoche has been directly confronted with the necessity of reducing selenium loads into the San Joaquin River, and as a result has adopted a variety of policies that are geared towards encouraging farmers to reduce or eliminate their drainage. Many farmers in the district, including two who are included in this report, have changed their irrigation practices as a result of these policies.

Sherman Boone in Denair. Releasing beneficial insects into his orchards and growing a cover crop both to improve soil fertility and provide habitat for beneficial insects, Sherman has eliminated synthetic insecticide use and reduced synthetic herbicide by 33 percent and synthetic nitrogen fertilizer by 50 percent.

Claude and Linda Sheppard in Chowchilla. Using beneficial insects, and other IPM techniques, the Sheppards have completely eliminated use of synthetic pesticides. They have also adopted irrigation water management techniques that have kept their water use 25 percent below the regional average for cotton.

Craig McNamara in Winters. Growing cover crops for weed and insect control and for soil building, and using insect mating disruption techniques for codling moth, on half of his acreage Craig has reduced synthetic herbicide by 35 percent and reduced synthetic nitrogen fertilizer use by 50 percent.

Doug Hemley in Courtland. Using insect mating disruption techniques to address codling moth problems, Doug has reduced insecticide use by 50 percent.

Steve Nishita in San Juan Bautista. Using a linear move irrigation system, Steve has reduced water use, improved irrigation efficiency, reduced labor costs and improved yields on his farm.

Mark Gibson in Hollister. Relying on beneficial insects and a cover crop Mark has completely eliminated use of synthetic pesticides and fertilizers in his walnut orchards, and eliminated use of synthetic insecticide, herbicide, and fertilizer use in his apricot orchards.

RECOMMENDATIONS

The farmers profiled in this report illustrate with their practices the changes that are possible in resource management. These case studies clearly demonstrate that farmers *can* significantly reduce their water use, as well as their reliance on synthetic pesticides and fertilizers. At this time, however, the farmers who are choosing to use these techniques are in the minority. While there are many factors that affect the choice of farming techniques, there is much that can be done on a policy level, using a mix of incentive-based and regulatory programs, to encourage increased use of sustainable farming techniques.

Sustainable agriculture does not compete on a level playing field: farmers are often faced with water rates that do not reward conservation, tax policies that encourage the use of pesticides, processing and marketing infrastructure that penalizes organic growers, and other disincentives to sustainable agriculture. We recommend the following enforcement, monitoring, research and development, technical assistance, and economic incentive programs to promote sustainable agriculture.

Enforcement

- ⇒ Congress should maintain and strengthen key environmental laws. In particular, Congress should amend the Clean Water Act to provide tougher controls on polluted runoff and more aggressively promote pollution prevention. The Administration should vigorously implement and enforce these laws.
- ⇒ The Bureau of Reclamation should implement the water conservation planning requirements of the Reclamation Reform Act and the Central Valley Project Improvement Act. The case studies in this report illustrate that there are a wide range of cost-effective techniques available to farmers that would help achieve the conservation goals embodied in these laws. The government must use its authorities to provide meaningful leadership.
- ⇒ States have an affirmative responsibility under the Clean Water Act to identify impaired waters and to establish Total Maximum Daily Loads (TMDLs) for stressors of concern for those waters. In cases such as California where the state has failed to meet its responsibilities, the law requires EPA to act. Therefore, EPA must establish TMDLs for all impaired waters in California, including implementation plans to achieve the limits set forth in each TMDL. The State has long failed to meet its responsibilities under the Clean Water Act to develop TMDLs, and EPA intervention is warranted and overdue.
- ⇒ EPA should enforce the new Food Quality Protection Act which protects infants and children from exposure to particularly hazardous pesticides.
- ⇒ The CALFED program, a joint federal/state planning effort for the Bay-Delta, should make conservation and pollution prevention programs the central approach to achieving water quality and water supply reliability goals. These programs should include performance targets and enforcement mechanisms to assure compliance.

Monitoring

- ⇒ The state should develop and maintain a comprehensive water quality monitoring program, with uniform testing protocols, to develop better baseline information regarding the source and level of pollutants throughout the state's waters, and over time to evaluate the impacts of targeted pollution prevention programs.
- ⇒ Water quality monitoring should include tracing pollutants back to their source, to facilitate development of targeted source reduction programs. Current testing frequently focuses on evaluating the toxicity of a water source to various indicator

species, but usually fails to isolate the cause of the toxicity, and to trace it back to its source.

- ⇒ The state should assure stable, long-term funding for water quality monitoring programs in order to develop meaningful data on pollutant trends. Interruptions of data collection due to inadequate funding or other reasons can make it difficult or impossible to perform meaningful analysis of water quality trends.

Technical Assistance

- ⇒ Site specific information is of great value for selecting appropriate water conservation or pesticide use reduction measures. The state and federal governments should fully fund a Mobile Irrigation Lab Program to do site specific evaluations and follow up. Funding for these labs has been extremely limited in recent years.
- ⇒ The state should fund on-farm demonstration projects incorporating water conservation and chemical use reduction strategies.
- ⇒ Farmer to farmer networking programs such as the Biologically Integrated Orchard Systems (BIOS) program coordinated by the Community Alliance with Family Farmers (CAFF) have played a pivotal role in providing farmers with the information and technical assistance they need to adopt alternative pest management systems. Programs such as these should be supported and expanded.
- ⇒ Resource Conservation Districts (RCDs) are a valuable, underutilized resource. RCDs were formed as an independent local government liaison between the federal government and private landowners. When motivated and given the necessary resources, RCDs can play a valuable role in offering technical assistance and promoting sustainable farming practices. However, many RCDs do not have any source of income and are thus severely limited in the conservation assistance that they can offer. The state and federal governments should consider providing a permanent source of funding for RCD pollution prevention and resource conservation programs.
- ⇒ USDA should increase its efforts to identify and disseminate alternatives to particularly hazardous pesticides.

Research and Development

- ⇒ Research should be conducted on alternative pest management strategies that are designed to prevent pest problems from developing and reduce reliance on pesticides. Research priorities include the use of cover crops, crop rotations, biologically-based materials such as pheromones and enhancement of natural predator populations.
- ⇒ Research should be done to determine the relationship between cover crops and water-use, and to develop low water use varieties.

- ⇒ Additional research is needed on the relationship between soil fertility, pest management and water use. Farmers in these case studies found that soil fertility was key to reducing chemical inputs. Some also found that an extensive soil building program could reduce water use.
- ⇒ Additional research dollars should be directed towards improving efficient irrigation technologies. Dramatic improvements in technology, especially in drip and subsurface drip irrigation, have been made in recent years. Continued advances in technology are possible and should be aggressively pursued.
- ⇒ Further research should be done to develop early varieties of rice and other water-intensive crops that benefit from winter and early spring rains and that can be harvested after a shorter growing season and less applied irrigation.

Economic Incentives

- ⇒ The federal government should phase out irrigation subsidies, which encourage wasteful use of water as well as cultivation of marginal quality lands where irrigation especially contributes to water quality problems.
- ⇒ Water deliveries should be measured to each farm, and farmers should be charged only for water they use. Although some farmers interviewed for this report adopted water conservation technologies despite water rate structures that discouraged conservation, many spoke disparagingly of rate structures that charged farmers on a per-acre basis regardless of water use. These rate structures promote waste, not conservation.
- ⇒ The state should renew and expand its system of revolving fund loans for irrigation system upgrades. Such assistance can help overcome the obstacle of high up-front capital costs, which may otherwise dissuade farmers from adopting cost-effective technologies.
- ⇒ Financial incentive programs should be tied to a whole farm approach that addresses water use, water quality, soil health and erosion, and chemical use reduction. This will avoid shifting environmental problems from one medium to another, and will also help focus resources on measures and techniques that have multiple benefits. The USDA program described in the West Stanislaus case study demonstrates that such an approach can be extremely effective in achieving water conservation and water quality benefits.
- ⇒ The CALFED Bay-Delta Program should condition the receipt of any program benefits by agricultural water users on implementation of conservation measures, including water measurement and volumetric pricing to promote conservation.
- ⇒ Pesticides should be taxed according to their toxicity. Higher taxes should be placed on the more toxic chemicals, including those that are scheduled to be

phased out, to give extra incentives for early replacement with less toxic alternatives.

- ⇒ Congress should appropriate full funding for the President's Clean Water Action Plan. The fiscal year 1999 funding initiative calls for a total increase of more than \$568 million for improved polluted runoff controls, watershed restoration, and public health protections.
- ⇒ Federal resources for polluted runoff, in particular new money under the USDA's Environmental Quality Incentives Program (EQIP) and the EPA's Clean Water Act funds (both slated for increases in the President's Clean Water Action Plan), should be targeted to high priority watersheds for which watershed restoration programs have been developed.

*Authors of this report:
 Ronnie Ann Cohen
 Jennifer Cantie
 Give credit to above
 and NRDC*



40 West 20th Street
 New York, NY 10011
 212 727-2700
 Fax 212 727-1773

1200 New York Avenue, N.W.
 Washington, DC 20005
 202 289-6868
 Fax 202 289-1060

71 Stevenson Street
 San Francisco, CA 94105
 415 777-0220
 Fax 415 495-5996

6310 San Vicente Boulevard
 Los Angeles, CA 90048
 213 934-6900
 Fax 213 934-1210

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